

$$T = 2\pi \sqrt{\frac{L}{g}}$$

Name: _____ Date: _____

Insights

Using a Pendulum to Measure the Acceleration Due to Gravity

A freely falling object accelerates at a rate that depends on the force of gravity. Near the surface of the earth, acceleration due to gravity (g) is equal to approximately 9.8 m/s^2 .

Materials:

- Protractor
- Ring stand
- String with pendulum bob attached
- Test tube clamp with a rubber cork inserted. The cork should have a slit you can put the string in.
- Timer
- Balance
- ruler

Part A: Does the angle the pendulum is released affect its period of motion (T)?

1. Set up your ring stand with the clamp open downward.
2. Mass the ball and the string.
3. Insert the string through the rubber cork and make the length of the string 25 cm. Make sure the ball does not hit the base of the ring stand.
4. One student should hold the protractor toward the top of the clamp. Another student should have the time and make sure the ball is released from an angle of 10 degrees. The third student should hold and release the ball.
5. Release and time 10 back and forth motions. Start with zero when the ball is released. The timer person should start the timer the instant the ball is released. Repeat for three measurements and then find the average time. Repeat this step for angles of 20 degrees and 30 degrees. **Make observations about the velocity of the ball.**
6. Calculate the period by dividing the time by ten.

Data:

Mass of the ball and string _____

Data Table 1.

Starting Position (degrees)	Time for 10 Swings (seconds)	Period (seconds)
10 degrees		
10 degrees		
10 degrees		
20 degrees		
20 degrees		
20 degrees		
30 degrees		
30 degrees		
30 degrees		

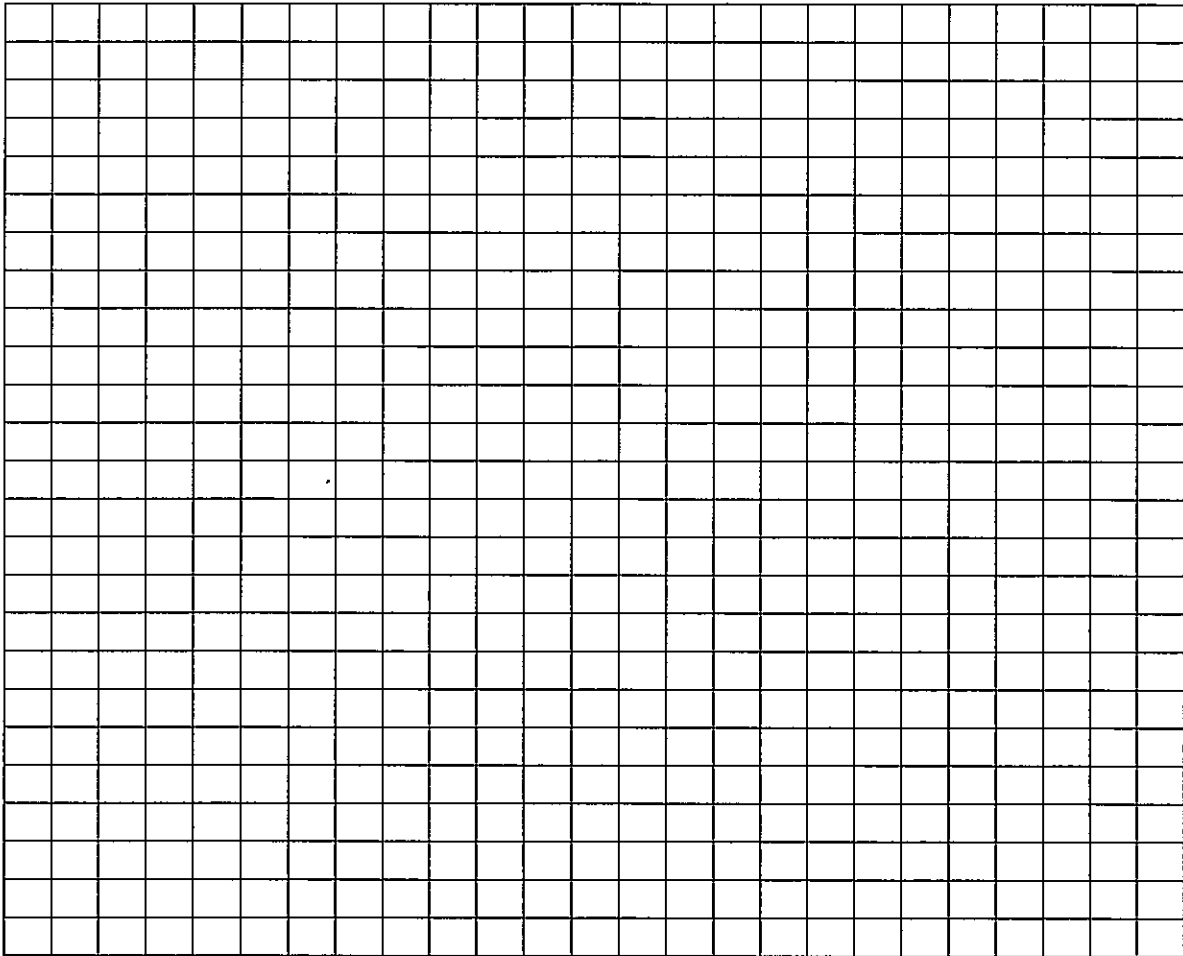
Average period for 10 degrees: _____ Show your work neatly!

Average period for 20 degrees: _____

Average period for 30 degrees: _____

State your observations about the speed of the ball.

Make a graph of your data below: Make a title, label the axes correctly (angle on the Y axis and the period on the X axis), plot the three average periods, and make a line through the points.



1. When was the velocity the greatest on the pendulum? Draw a sketch of the pendulum and show where the speed was the greatest?
2. Where was the acceleration the greatest?
3. How did the angle affect the speed of the maximum speed of the pendulum?

Part B: Finding the value for gravity with a pendulum. Show all math work.

1. Using the protractor to measure the angle, position the mass at an angle of 20 degrees. Have a group member start the stopwatch at the instant you release the mass. Measure the time the pendulum takes to complete 20 back and forth swings. Record this data in Data Table 2. The length of your string should still be at 25 cm.
2. Repeat step one, but change the length of the string to 35 cm.
3. Repeat step one again, but change the string length to 50 cm.
4. Calculate the period for each by dividing the time by 20.
5. Use the following equation to calculate the value for gravity for each length:

$$g = 39.5 \times \frac{\text{Length (L)}}{\text{Period (T)}}$$

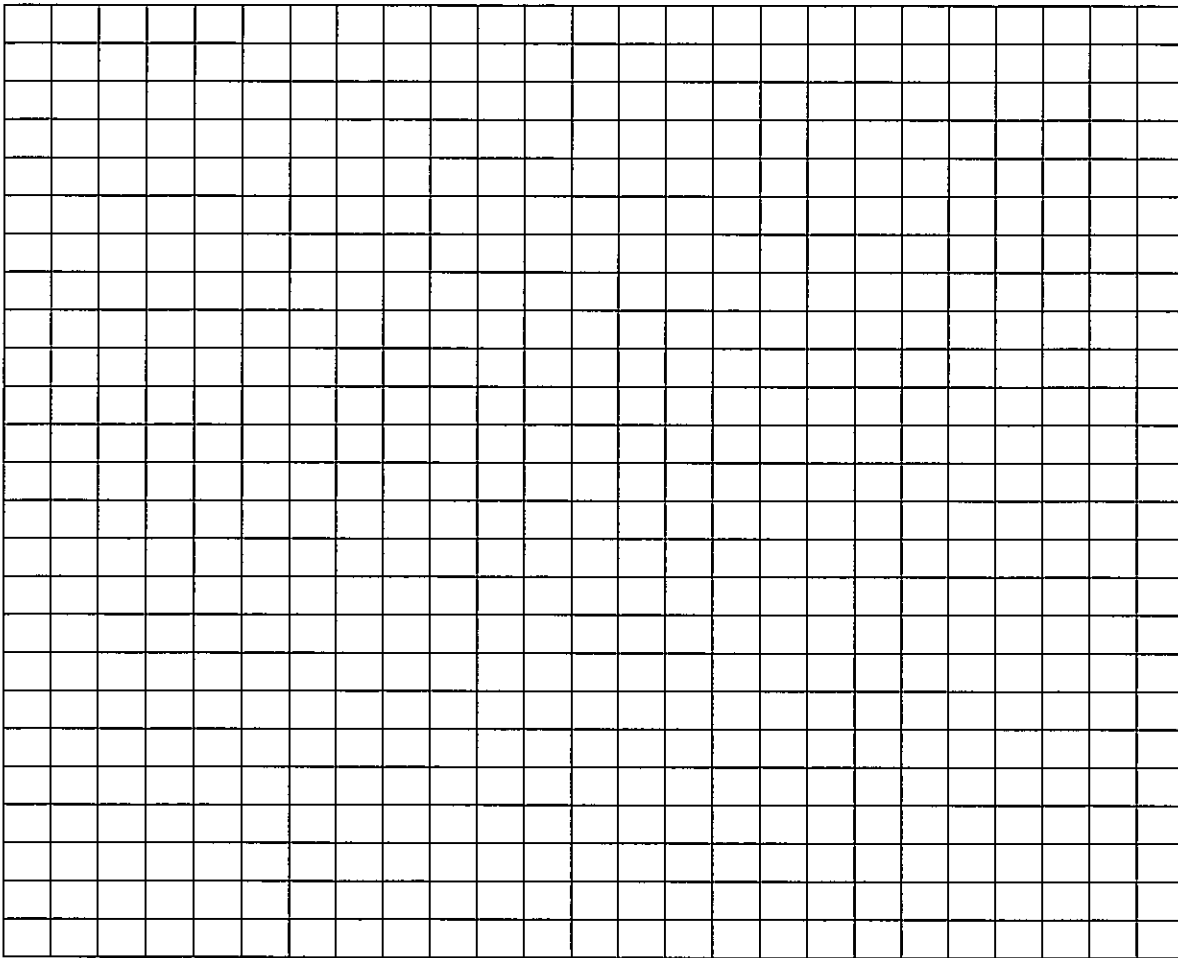
Calculate the experimental error for each of your 'g' values. Use the following equation:

$$\frac{|\text{Experimental} - \text{Accepted}|}{\text{Accepted value}} \times 100$$

Data Table 2.

Length of the Pendulum			
Time for 20 swings (seconds)			
Period (seconds)			
Calculated Value of g (m/s ²)			
Accepted value of g (m/s ²)			
Percent Error (%)			

6. Make a graph of you data:



Did your calculated values for g differ from the accepted value of $9.8 \text{ (m/s}^2\text{)}$. If they did differ explain why.

How did the length of the pendulum affect the period?

Calculate the force on the pendulum using the average of your measured ' g ', 10 degrees and the mass. Use the following equation: $F = ma \times \sin \theta$. Express your answer in Newtons.

$F = -m \times a \times \sin \theta$ Where m = mass in Kg; $a = g$ (your value) and θ = angle